

# Thoughts: LBNE vs. NuMI Beam

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- Much experience working with each system (NuMI since 1998; LBNE since 2008)
  - NuMI
    - Lead beam coordinator for 7 years of NuMI operations. Lead for building extraction and primary beam systems, plus some key efforts with facility design.
  - LBNE
    - Guided design development for initial MI-60 Deep beam layout prior to LBNE Project being formed.
    - Initiated and guided early development of new reference design MI-10 Shallow beam layout, late 2010. ( Save \$\$\$; fundamental improvement for mitigation of tritium issues)
  - 30 + years
    - Lead technical coordination of many beam-facility systems (all very successful), starting in 1978. Tight budgets were the norm.
- **Hopefully, biases are equalized between NuMI and LBNE, and senility has not yet taken over.**
- **I will not give my personal bias of which beam we should go with. Goal is to provide information to help a physics based decision.**

# NuMI Beam: Pros and Cons

- **Pros:**

- It exists !
- Successful operation to 350+ kW, increasing since 2005. Upgrades designed and to be installed starting next week for 700 kW capability.

- **Several technical challenges:**

- ~ 4 years ago; convert from vacuum to He filled decay after corrosion seen on vacuum window (accomplished without incident)
- One year (2011) of sustained target problems, with 5 target changes required (QC with 2<sup>nd</sup> batch of supplied targets)
  - Impressive effort by Targetry team to accomplish this, plus design fix for problems
- **Groundwater tritium mitigation.**
  - Many interventions to control, since 2006. Effort continues.
  - Major problem has been due to mobility of tritium in air from moist target hall to wet decay tunnel - located in protected aquifer.

# Further NuMI Upgrade Capability?

- Question any plan for sustained operation well above 700 kW (SNUMI ~ 2006). Many difficulties from Tritium mitigation to practical neutrino beam system cooling limits. Very difficult to work in high radiation areas not designed for retrofit.
- A better option could be to build a new LBNE style beam (but slightly shorter decay) upstream of current NuMI target hall. Could then have capability for Project X beam.
  - This appears to fit well on available site with minimal rework of existing facilities.
  - Could aim either at Soudan or Ash River
  - **But** would be a Phase II effort. Comparable to LBNE to SD construction from target hall downstream. And current NuMI beam goes away.

# LBNE Beam: Pros and Cons

- **Pros:**

- Good designs (beam and facility) exist for most systems. Very positive feedback from March Director's Review.
- Should be readily upgradable where needed for Project X capability

- **Cons:**

- **It does not exist.**
- **Current design is too expensive**
  - We have to make major reductions in beam–facility cost to have a credible option for beam plus surface detector to South Dakota **and** accomplish this without major degradation of beam capabilities.

- **Is this feasible?**

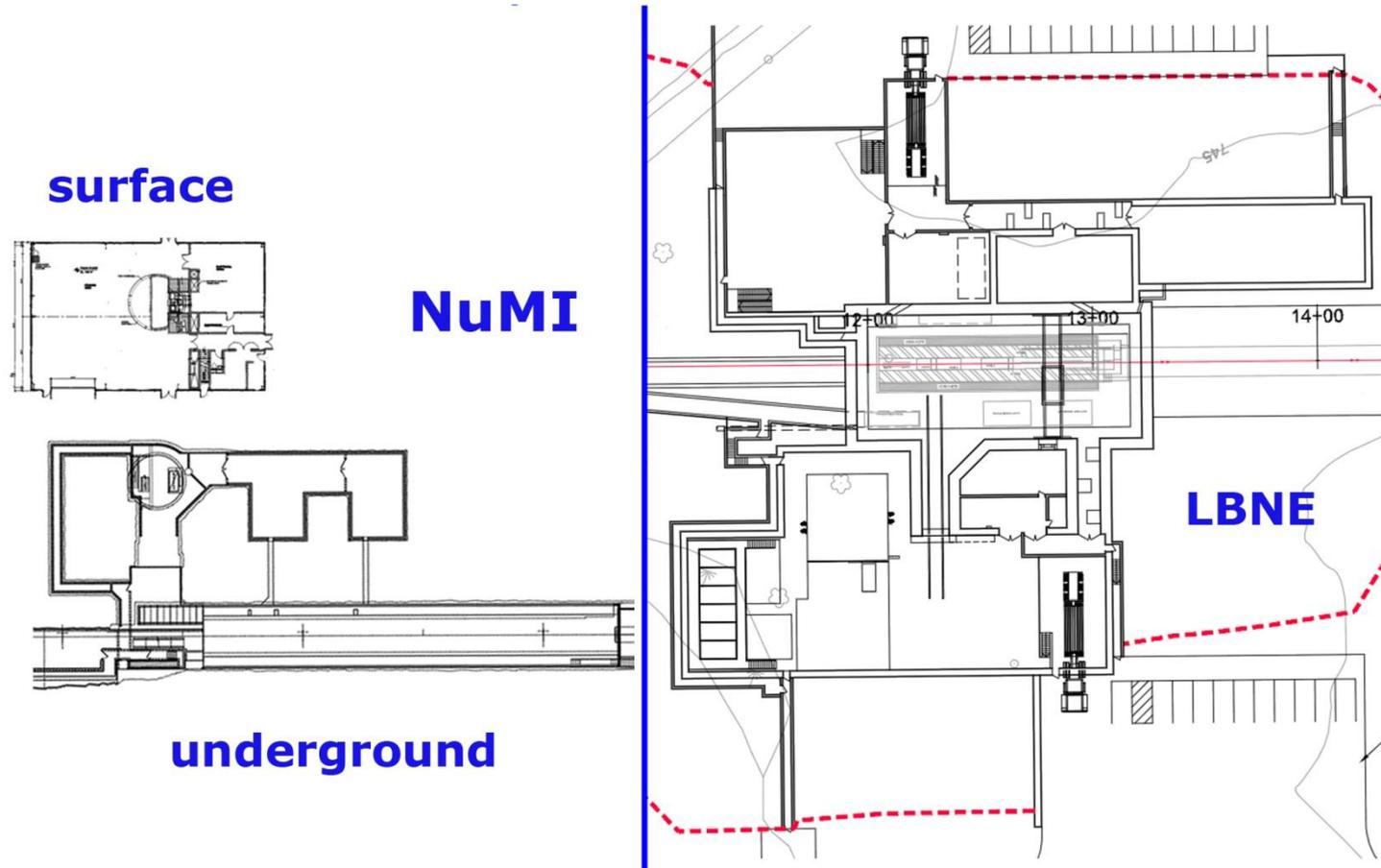
- Actually, yes.

# A More Cost Efficient LBNE Beam

- Vaia's talk yesterday detailed ~ \$60M in potential LBNE beam-facility cost reductions, but can not all be added together. Most were from beam; fewer from facility changes.
- To gain additional reductions of this much again, we need to:
  - Insure our beam-facility designs are well matched for optimal cost efficiency. This does **not** require giving up capabilities. Just accomplishing them with more cost efficient designs for our current beam configuration.
  - Change from a Deep to a Shallow LBNE beam design was very major, and recent. Task to optimize facility designs for this new beam configuration is really just starting.
  - Continue to evaluate what we need to have versus what we would like to have.
    - Fortunate to have many talented people working with LBNE. They know how to make systems better. Now we need more affordable, also. This is a more challenging problem, but we have the people to accomplish this.

# LBNE vs/NuMI Target Hall: Plan View to Same Scale

(NuMI: 0.4-0.7 MW; LBNE: 0.7-2.3 MW)



# Needed \$ Goal for LBNE Beam-Facility

- Beam-facility combined cost (TPC, no escalation, no ND) at March review was ~ \$420 M.
- With the Phase I \$ cap we have been given, a 5-10 kT surface detector at South Dakota could be built if we can work within a Beam-Facility budget of ~ \$300 M.
- And yes, we can do this, while maintaining robust beam design capabilities!
  - **Experienced detailed coordination between beam and facility systems is essential.**